

## Plasma-on-Chip

Meijo Univ.<sup>1</sup>, Osaka Med. Col.<sup>2</sup>, Gladstone Inst.<sup>3</sup>, Osaka City Univ.<sup>4</sup>, AIST<sup>5</sup>, Toyota Technol. Inst.<sup>6</sup>

°Shinya Kumagai<sup>1</sup>, Mime Kobayashi<sup>2</sup>, Kiichiro Tomoda<sup>3</sup>, Jun-Seok Oh<sup>4</sup>, Tetsuji Shimizu<sup>5</sup>, Minoru Sasaki<sup>6</sup>

E-mail: skumagai@meijo-u.ac.jp

Cold atmospheric pressure plasma (CAP) has opened up a new research field in biology and medicine. Many researchers have been trying to elucidate CAP-cells interaction mechanisms. However, there is still a big controversy on the mechanism. What is actually happening inside the cells? To answer the question, we have developed a microdevice referred to as the *Plasma-on-Chip*. As shown in Fig. 1, the *Plasma-on-Chip* device uses air-liquid interface formed by surface tension of liquid medium, and thus enables to irradiate cells directly with CAP. In this talk, prospects of how the *Plasma-on-Chip* device can make an innovation happen in plasma-bio research fields.

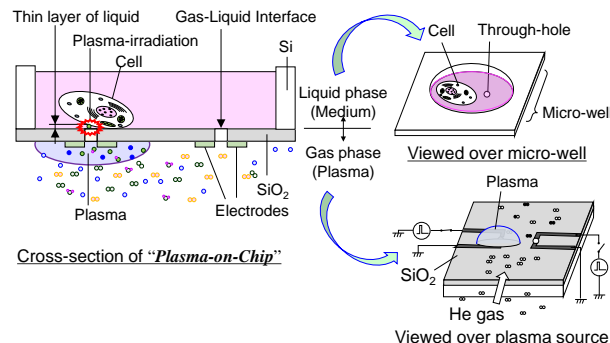


Fig. 1: Structure of *Plasma-on-Chip*.

**Funds** JSPS KAKENHI (26600130, 18K19942, 19H04457), Toyoaki Scholarship Foundation, The Uehara Memorial Foundation, and Ichihara International Scholarship Foundation. A part of our studies on microdevices was carried out at Toyota Technological Institute with funding from the MEXT “Nanotechnology Platform” project.

## References

### Microdevice (Development of *Plasma-on-Chip*)

- [1] Kumagai et al., “Development of plasma-on-chip: Plasma treatment for individual cells cultured in media”, Jpn. J. Appl. Phys. **55**, (2016) 01AF01. (OPEN ACCESS)
- [2] Okada et al., “Plasma-on-chip device for stable irradiation of cells cultured in media with a low-temperature atmospheric pressure plasma”, Arch. Biochem. Biophys. **605**, (2016) 11.
- [3] Kumagai et al., “*Plasma-on-Chip*: device for non-thermal atmospheric pressure plasma irradiation to single cells”, Electron Comm Jpn., **103**, (2020) 43. <https://doi.org/10.1002/ecj.12263> (OPEN ACCESS)

### Analysis (ROS, gene expression)

- [4] Oh et al., “Plasma cell treatment device *Plasma-on-Chip*: Monitoring plasma-generated reactive species in microwells”, Sci. Rep. **7**, (2017) 41953. <https://doi.org/10.1038/srep41953> (OPEN ACCESS)
- [5] Kobayashi et al., “Direct plasma irradiation affects expression of RNAs in cultured mammalian cells”, Appl. Phys. Express. **9**, (2016) 127001.

### iPS cells

- [6] Kobayashi et al., “Low temperature plasma for controlling iPS cell differentiation”, the GEC19 Meeting of The American Physical Society, 2019.